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(54) FABRICABLE NON-CROSSLINKED POLYPROPYLENE RESIN FOAMED SHEET

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a foamed sheet having fine cells ad excellent appearance and rigidity by specifying the extrusion conditions, the die structure and the closed-cell content.

SOLUTION: This invention provides a fabricable non-crosslinked polypropylene resin foamed sheet having a density of 0.09-0.4g/cm3, a thickness of 0.5-8mm and a closed-cell rate of 70% or above, wherein the cell shape satisfies the following relationships (1) to (3) (wherein A, B and C are the mean cell diameters mm in the directions of thickness, extrusion and width of the sheet). To obtain a sheet which can satisfy the relationships, the temperature of the ring die at the tip of an extruder is lowered to the limit temperature at which the resin does not crystallize in an accurately controlled manner to permit the resin in a highly viscous state to pass the die, and a die in which a secondary breaker in such a form as to permit the resin to flow as a piston flow is contained and which has such a structure that the inside of the die is suddenly constricted at the lip top is used. The blowing agent is used in an amount of 0.05-0.5mol when it is a volatile one, and in an amount of about 0.03-0.45mol when it is an inorganic or a decomposable one.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the non-constructed bridge polypropylene regin foaming sheet for shaping.
[0002]
[Description of the Prior Art] Before, the foam of low density is obtained from the high density using a specific polypropylene regin. It is density 0.09 g/cm3 also in it. The above foaming sheet is mainly used as a foaming sheet for shaping, and a printability and the beauty of the appearance of mold goods obtained are required of such a foaming sheet for shaping.
[0003] However, the polypropylene regin foaming sheet known until now had the defect that air bubbles were a little coarse and difficulty was in appearance as compared with the foaming sheet which consists of polystyrene system resin which occupies most foaming sheets for shaping. And although the polypropylene regin could not maintain the high rate of a closed cell when air bubbles were made fine for appearance improvement, since the melt viscosity at the time of foaming was low compared with polystyrene system resin etc., and the diameter of air bubbles of the thickness direction of a sheet became small, it had the problem that a cellular configuration will turn into the flat shape of an ellipse short in the thickness direction of a sheet, and will become a rigid inadequate sheet.
[0004] Furthermore, in obtaining a foaming sheet using a polypropylene regin, extrusion foaming of the foaming sheet is carried out to the shape of a cylinder from an annular dice. Although it is common to manufacture by passing the cylinder side top of the cylindrical cooling system called a mandrel, and clearing cylinder-like foam in the shape of a sheet after that If it is going to make the air bubbles of a foaming sheet fine in that case, foaming will take place rapidly in three dimensions, and the resin which foaming speed became quick and was extruded from the annular dice will serve as cylinder-like foam which has a bigger path than the diameter of a dice. Then, Siwa of the a large number book which flows to the foam direction of extrusion according to the difference of the diameter of a dice and the path of cylindrical foam as cylindrical foam was extracted with the dice just like a gathered skirt occurred in the peripheral surface of cylindrical foam (this Siwa is called the KORU gate), and the problem that the heterogeneity of the thickness nonuniformity of a sheet or air bubbles resulting from this will arise crosswise [of a sheet] also had it. Moreover, since the pillar of the secondary breaker supporting the annular dice of an extruder will be located in the passage of resin and resin will be interrupted within an extruder with this secondary breaker, the problem that thickness nonuniformity will arise is also in a foaming sheet that it is hard to come out of the thickness of that portion (this thickness nonuniformity is called a breaker mark), and it had become the cause from which this also prevents the homogeneity of the thickness of the cross direction of a foaming sheet. And if thermoforming of the foaming sheet which has uneven description crosswise [of a sheet] by such corrugated one or the breaker mark was carried out, since especially a portion with thin thickness would be lengthened and fabricated, the mold goods obtained lacked in appearance or rigidity.
[0005] By the way, in order to solve the above breaker marks, these people adopted the method of

forming drawing in the part in the dice of the downstream of a secondary breaker in JP,5-338055,A. However, since drawing in such a dice raised the pressure of the dice section, it needed to restrict the discharge quantity of the resin from an extruder to the fixed range. For this reason, in order to obtain a foaming sheet using a polypropylene regin It is necessary to press down the discharge quantity of the resin from an extruder in a fixed range. Moreover, since the corrugated cure is inadequate, The polypropylene regin foaming sheet which it was difficult to make air bubbles fine, and was obtained under such a limit As compared with the foaming sheet for shaping currently used widely, it cannot yet be satisfied fully about the beauty of a printability or appearance, and the room of an improvement was left behind also about productivity.

[0006] Then, this invention persons are adopting the dice of specific extrusion conditions and specific structure, as a result of repeating research wholeheartedly. While air bubbles are fine, being able to obtain the polypropylene regin foaming sheet which is excellent also in appearance or rigidity and specifying the density, thickness, and the rate of a closed cell in such a polypropylene regin foaming sheet especially When making it a cellular configuration also turn into a specific configuration, the physical properties of a foaming sheet, such as rigidity, improve. A moldability, the appearance of the foaming sheet itself, the appearance of the mold goods obtained further, etc. came to complete a header and this invention for becoming what was more excellent compared with the polypropylene regin foaming sheet known conventionally.

[0007]

[Means for Solving the Problem] That is, this invention is a non-constructed bridge polypropylene regin foaming sheet for shaping which is a non-constructed bridge polypropylene regin foaming sheet for shaping of 0.5-8mm in ** density 0.09 - 0.4 g/cm3, and thickness, and 70% or more of rates of a closed cell, and is characterized by a cellular configuration satisfying following the (1) - (3) type.

$0.35<A/B<0.65$ ... (1)

$0.35<A/C<0.65$ ... (2)

$0.10 -- < -- A <=0.4$ ... (3)

[-- however, each in [A, B, and C] a formula is a diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD), and the unit is mm.]

** About air bubbles which exist in the surface section of less than 25% of overall thickness Mino of this sheet from a front face of a foaming sheet A diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A1, B1, and C1, respectively. and about air bubbles which exist in the inner layer section which crosses 25% of overall thickness Mino of this sheet from a front face of a foaming sheet A non-constructed bridge polypropylene regin foaming sheet for shaping given [above-mentioned] in ** it is satisfied with of following the (4) - (6) type when a diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A2, B-2, and C2, respectively.

$0.8<A1/A2 <=1.2$ ... (4)

$0.8<B1/B-2<=1.2$ ... (5)

$0.8<C1 / C 2<=1.2$ ... (6)

** The above-mentioned ** whose ratio (Tl/Tm) of the maximum thickness (Tm) in within the limits and the minimum thickness (Tl) of each which is divided at intervals of 100mm from one piece side edge section over the cross direction (the direction of TD) to the piece side edge section of another side is 0.90 or more when thickness is measured along the cross direction (the direction of TD) of a foaming sheet, or a non-constructed bridge polypropylene regin foaming sheet for shaping given in **.

** The above-mentioned ** which comes to carry out the laminating of the resin sheet of 5 - 70 % of the weight of inorganic filler contents with a thickness of 200 micrometers or less to at least one side, **, or a non-constructed bridge polypropylene regin foaming sheet for shaping given in **. It considers as a summary.

[0008]

[Embodiment of the Invention] Hereafter, this invention is explained to details based on a drawing.
[0009] It is a mimetic diagram based on the microscope enlargement which expresses the thickness direction cross section where drawing 1 (a) meets the direction of extrusion (henceforth the direction of MD) of the non-constructed bridge polypropylene regin foaming sheet for this invention shaping, and the thickness direction cross section where drawing 1 (b) meets crosswise [of the non-constructed bridge polypropylene regin foaming sheet for this invention shaping] (henceforth the direction of TD), respectively, and is drawing for explaining the cellular configuration of this invention foaming sheet.
[0010] One expresses this invention foaming sheet among drawing, and 2 expresses air bubbles. Respectively a (a1, a2, and a3, ..., an) Moreover, the path of the thickness direction of the foaming sheet 1 of air bubbles 2, b (b1, and b2, b3, ..., bn) expresses the path of the direction of MD of the foaming sheet 1 of air bubbles 2, and c (c1, c2, and c3, ..., cn) expresses the path of the direction of TD of the foaming sheet 1 of air bubbles 2, respectively.
[0011] In this invention, the direction where resin in case the direction of MD obtains the foaming sheet 1 using an extruder is extruded is said, and the direction of TD means the direction of width of face to the direction of extrusion. Moreover, the thickness direction of the foaming sheet 1, the direction of MD, and the direction of TD intersect perpendicularly mutually, respectively.
[0012] this invention foaming sheet 1 replaces with A [(a1+a2+a3+ ... +an) /n] which is the average of a. [(b1+b2+b3+ ... +bn) /n] which is the average of b is replaced with B. When [(c1+c2+c3+ ... +cn) /n] which is the average of c is replaced with C and expressed It has (however, the diameters A, B, and C of average air bubbles are the averages about 50 or more (n>=50) air bubbles of arbitration, and set the unit of A, B, and C to mm), and the cellular configuration with which A, B, and C are satisfied of following the (1) - (3) type.
$0.35<A/B<0.65$ ... (1)
$0.35<A/C<0.65$ ... (2)
$0.10 -- < -- A <=0.40$ ... (3)
[0013] If either is 0.35 or less even if there are little A/B and A/C at this time Although the rigidity of the foaming sheet 1 becomes imperfection, what has the cross-section configuration of air bubbles where A/B and a foaming sheet [as / whose either is 0.65 or more at least] of A/C are close to a circle is ideal as a cellular configuration and the well-balanced mechanical physical properties can be expected If the foaming temperature of resin and the addition of a cellular regulator are adjusted when the diameter A of average air bubbles tends to obtain a foaming sheet with the cellular cross-section configuration near a circle within the limits of the above-mentioned (3) formula, corrugated one and thickness nonuniformity will occur and it will become a thing also inferior to a moldability. Moreover, if A becomes 0.1 or less, it becomes difficult to maintain the rate of a closed cell of the foaming sheet 1 to 70% or more, the post expansion nature of a foaming sheet will fall, and a moldability will get worse, and mechanical physical properties, such as rigidity, will also become low. The nonconformity that air bubbles are coarse and the appearance of the foaming sheet 1 will get worse produces that to which A exceeds 0.4. this invention -- setting -- A/B and A/C -- each -- desirable -- it is -- a range -- $0.45<A/B -- < --$ it is 0.55 and $0.45<A/C<0.55$. Moreover, the desirable range of A is $0.15< A<0.3$.
[0014] In each of air bubbles 2, it is not necessary to necessarily satisfy the above-mentioned conditional expression in this invention. That is, for example, it is not necessary to be necessarily $0.35<a1/b1<0.65$, $0.35<a1/c1<0.65$, and $0.10<a1<=0.40$. In this invention Moreover, the value of [(path of the thickness direction of the foaming sheet 1) / (path of the direction of MD of the foaming sheet 1)] for every air bubbles 2, The average of all air bubbles is not it is larger than 0.35 and smaller than 0.65, either. Moreover, the average of all air bubbles of the value of [(path of the thickness direction of the foaming sheet 1) / (path of the direction of TD of the foaming sheet 1)] for every air bubbles 2 is not it is larger than 0.35 and smaller than 0.65, either. namely, $0.35<[(a1 / b1) +(a2 / b2) +(a3 / b3)+ ... +(an/bn)] / n< 0.65$ -- not but Moreover, $0.35<[(a1 / c1) +(a2 / c2) +(a3 / c3)+$ ... It is not $+(an/cn)] / n< 0.65$.
[0015] In addition, a1 of each air bubbles, a2, and a3 ..... an, b1, b2, and b3 ..... bn, c1, c2, and c3 ..... The maximum tangent gap of the tangent to each air bubbles of the thickness direction as shown in drawing 2 , the direction of MD, or the direction of TD shall be used for the value of cn (n is 50 or

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more). Moreover, each path of the thickness direction of each air bubbles 2, the direction of MD, and the direction of TD can obtain each microscope enlargement of the thickness direction cross section which meets in the direction of MD of the foaming sheet 1, and the thickness direction cross section which meets in the direction of TD of the foaming sheet 1, and can ask for it based on the acquired photograph.

[0016] As shown in drawing 1 , in this invention, less than 25% of portion of the thickness of 0.25T of all thickness T of this sheet 1 from each of both the front faces S and S of the foaming sheet 1 Furthermore, the surface section Ts, When it is referred to as Ts and the portion of the thickness of 0.5T which exceeds 25% of all thickness T of this sheet 1 from each of both the front faces S and S of the foaming sheet 1 is made into the inner layer section Ti About the air bubbles which exist in each of the surface sections Ts and Ts and the inner layer section Ti, independently About the air bubbles which ask for the diameter of average air bubbles the same with having mentioned above, and exist in the surface section Ts The diameter of average air bubbles in the thickness direction of the foaming sheet 1, the direction of MD, and the direction of TD is set to A1, B1, and C1, respectively. And when the diameter of average air bubbles in the thickness direction of the foaming sheet 1, the direction of MD, and the direction of TD is set to A2, B-2, and C2 about the air bubbles which exist in the inner layer section Ti, respectively, it is desirable that A1, B1, C1, A2, B-2, and C2 have the cellular configuration with which are satisfied of following the (4) - (6) type.

$0.8<A1/A2 \leq 1.2$ ... (4)

$0.8<B1/B\text{-}2 \leq 1.2$ ... (5)

$0.8<C1 / C\,2 \leq 1.2$ ... (6)

[0017] In addition, air bubbles [in / on this invention and / drawing 1] 20 Like, both the front faces S of the foaming sheet 1 When [of all thickness T of each of S to the foaming sheet 1] air bubbles exist on 25% of location ranging over the surface section Ts and the inner layer section Ti respectively, they are air bubbles 20. If the portion exceeding 50% of the cross section is located in the surface section Ts side These air bubbles shall exist in the surface section Ts, and are air bubbles 20. If the portion exceeding 50% of the cross section is located in the inner layer section Ti side, these air bubbles shall exist in the inner layer section Ti.

[0018] A cellular configuration has little variation in the surface section Ts of the foaming sheet 1, and the inner layer section Ti, air bubbles become uniform in the thickness direction of the foaming sheet 1, and the foaming sheet 1 which has the cellular configuration with which are satisfied of the above-mentioned (4) - (6) type becomes what was more excellent in the moldability. Moreover, if air bubbles are uniform in the thickness direction of the foaming sheet 1, the rigidity of the foaming sheet 1 will improve further. On the other hand, the thing which does not fill the above-mentioned (4) - (6) type the air bubbles with which the air bubbles which exist in the surface section Ts exist in the inner layer section Ti -- comparing -- width -- as it is flat or many air bubbles small in irregular are intermingled The cellular configuration in the surface section Ts and the inner layer section Ti has much variation, the homogeneity of the air bubbles in the thickness direction of the foaming sheet 1 is spoiled, and surface YAKE of a sheet becomes easy to generate such a foaming sheet at the time of thermoforming. In this invention, it is $0.84<A1/A2 \leq 1.05$, $0.84<B1/B\text{-}2 \leq 1.05$, and $0.84<C1/C\,2 \leq 1.05$ that each of A1/A2, B1-/B-2, and C1/C2 is in the range of $0.82<A1/A2 \leq 1.10$, $0.82<B1/B\text{-}2 \leq 1.10$, and $0.82<C1/C\,2 \leq 1.10$ more desirable especially preferably.

[0019] The polypropylene regin foaming sheets 1 for shaping of this invention are 0.5-8mm in density 0.09 - 0.4 g/cm3, and thickness, and 70% or more of rates of a closed cell. It sets to this invention and the density of the foaming sheet 1 is 0.09 g/cm3. Since it is it easy to bend to firmness to be the following deficiently, sufficient rigidity is not acquired. Moreover, density is 0.4 g/cm3. If it exceeds, while becoming that in which rigidity is too strong and inferior to buffer nature, it will become a thing inferior to adiathermic.

[0020] especially -- this invention -- setting -- the density of the foaming sheet 1 -- 0.11 - 0.3 g/cm3 it is -- a thing is desirable. If it is this range, rigidity and buffer nature can be balanced and it can consider as the foaming sheet having fabricating nature with suitable sufficient rigidity for the activity as a foaming

sheet, good moderate buffer nature, moldability, etc.
[0021] Moreover, preferably, if it exceeds 8mm, it is not desirable in this invention, unless the thickness of the foaming sheet 1 fulfills 0.5mm in respect of a moldability in respect of adiathermic. Moreover, if the rate of a closed cell is not filled to 70%, sufficient sheet rigidity ****** will become that there is nothing. In this invention, the desirable thickness of the foaming sheet 1 is 1.5-3.0mm, and, as for the rate of a closed cell, it is desirable that it is 75% or more.
[0022] Since it is a cellular configuration more near a globular form, while the foaming sheet 1 of this invention is long in the thickness direction as compared with the former which satisfies the conditions which have specific density, thickness, and a rate of a closed cell, and the cellular configuration mentioned above, and having high rigidity and the outstanding buffer nature simultaneously it not only excelling in a moldability, but, it excels in appearance, compressive strength, and flexural strength.
[0023] Moreover, when the thickness is measured along the direction of TD, this invention foaming sheet 1 Each range alpha divided at intervals of 100mm from the piece side edge section to the piece side edge section of another side as while shows drawing 3 The foaming sheet 1 is divided in the direction of TD to beta, gamma, and ... (however, the portion eta of the remainder with which 100mm is not filled as shown in drawing 3 shall be disregarded). It is desirable that there is little thickness nonuniformity so that the ratio (Tl/Tm) of the maximum thickness (Tm) of the above-mentioned ranges alpha, beta, and gamma and the foaming sheet 1 out of which ... comes, respectively, and the minimum thickness (Tl) of the foaming sheet 1 may become 0.92 or more preferably 0.90 or more.
[0024] If there are each ranges alpha, beta, and gamma divided every 100mm and thickness nonuniformity from which the ratio (Tl/Tm) of the maximum thickness (Tm) of the foaming sheet 1 and the minimum thickness (Tl) of the foaming sheet 1 in ... becomes less than 0.90 Since the thin portion of a sheet is weaker than the thick portion of a sheet at the time of thermoforming, it will be lengthened locally, when extreme, a hole will open in mold goods or it will be easy to produce the nonconformity of a crack arising, and it will become a thing inferior to a moldability.
[0025] The polypropylene regin non-constructed a bridge is used for the base material resin of this invention foaming sheet 1. As this polypropylene regin, the copolymer of a propylene homopolymer or a propylene, and other olefins is mentioned. As a propylene and other olefins which can be copolymerized, the alpha olefin of the carbon numbers 4-10, such as ethylene, 1-butene and an isobutylene, 1-pentene, a 3-methyl-1-butene, 1-hexene, 3, a 4-dimethyl-1-butene, 1-heptene, and a 3-methyl-1-hexene, is mentioned. even if the above-mentioned copolymer is a random copolymer -- a block copolymer -- you may be -- further -- duality -- you may be not only a system but a ternary system copolymer. Moreover, it not only uses these polypropylene regins independently, but two or more sorts can be mixed and used for it.
[0026] When using the copolymer of a propylene and other olefins as base material resin, it is desirable that the olefin contains 25 or less % of the weight in a copolymer especially at 15 or less % of the weight of a rate. The lower limit with the desirable olefin content in a copolymer is 1 % of the weight.
[0027] in addition, a thing also including fine bridge formation according [no constructing a bridge as used in the field of this invention] to a peroxide and radiation -- it is -- a gel molar fraction -- less than 10% of the weight of a thing -- 0% of the weight of a thing is mentioned especially substantially less than 5% of the weight preferably. Moreover, a gel molar fraction performs extract operation in an ebullition xylene for 15 hours, and is called for as 100 molar fractions to resin extract Shigekazu Saki of a resin extract residue. At the time of extrusion foaming from an annular dice, its generating of the lump of resin also decreases on the foaming sheet obtained, and this gel molar fraction leads to appearance improvement, so that it is close to 0.
[0028] As [indicate / by the polypropylene regin / at JP,7-53797,A / moreover,] a) [whether it has less than one branching characteristic and remarkable strain-hardening elongation viscosity and] Or bz average molecular weight is 1.0x106. It is above, the ratio (Mz/Mw) of z average molecular weight (Mz) and weight average molecular weight (Mw) is 3.0 or more, and he is the balanced compliance J0.
[whether they are more than 1.2x10-4cm2 / dyn and] shearing distortion recovery Sr/S per unit stress -- per second -- usual [which is more than 5x10-5cm2 / dyn / of Above a and b] can also use a propylene

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polymer material without the gel of the amount of macromolecules which is a solid-state.
[0029] Moreover, as a polypropylene regin used by this invention, that c drawdown nature indicates 60m physical properties which it becomes the following by /to be is also mentioned. More desirable drawdown nature is the following by 30m/, and the following by 15m/especially preferably.
[0030] Drawdown nature is a part for 10mm/in piston press speed from a melt tension circuit tester's nozzle 21 (the aperture of 2.095mm, a length of 8mm) about the melting propylene system resin heated at 230 degrees C using the equipment shown in drawing 4 . After passing the tension detection pulley 22 which extrudes in the drawing Nakaya mark direction in the shape of a string, and is located in it in this string-like object subsequently to the lower part of the above-mentioned nozzle, and the delivery rolls 23, 24, and 24 located in the upper part, It scrapes off, while scraping off and scraping off with a roll 25, a roll scrapes off, shall make speed increase gradually, a string-like object shall be made to cut, the string-like object at the time of this cutting shall scrape off, and speed shall be said. In addition, it sets to the equipment to illustrate and is the distance L1 between a nozzle 21 and a pulley 22. The path R of 250mm and a pulley 22 is the distance L2 between 45mm, a pulley 22, and the delivery roll 23. Distance L3 between 90mm and the delivery rolls 23 and 24 The angle theta to the level surface of the tangent extended on the upper surface of the delivery roll 23 from the contact surface of 45mm and the delivery rolls 24 and 24 is 40 degrees.
[0031] Drawdown nature by 60m/the following propylene system resin the usual crystallinity -- a line -- propylene system resin (usually) They are 100000 or more weight average molecular weight. Moreover, in it An atactic part, Or/and, the resin containing the component which has not been crystallized although it is isotactic It receives (this resin is hereafter called "usual propylene system resin"), and usual 5-50 millimol addition of the peroxide (decomposition temperature: about room temperature -120 degree C) of a low-temperature resolvable type is carried out per 1kg of resin. To about 120 degrees C It can be made to be able to heat and react to about 70-105 degrees C preferably (usually for 30 - 120 minutes), and can obtain by the method of making atactic or/and the isotactic component which has not been crystallized combine with the principal chain of the above-mentioned usual propylene system resin as branched chain etc.
[0032] As a peroxide of the above-mentioned low-temperature resolvable type, JI (s-butyl) peroxi dicarbonate, screw (2-ethoxy) peroxi dicarbonate, dicyclohexyl peroxi dicarbonate, G n-propyl peroxi dicarbonate, G n-butylperoxy dicarbonate, diisopropyl peroxi dicarbonate, a t-butylperoxy neo DEKANO art, t-amyl peroxy NEODEKANO art, t-butyl pel OKISHIPI barat, etc. are illustrated.
[0033] The number and length of long-chain branching can adjust the drawdown nature of propylene system resin, and it is thought that the following propylene system resin has the letter structure of branching where the drawdown nature obtained as mentioned above has long-chain branching mainly at the edge of a principal chain by 60m/. The value which shows drawdown nature tends to fall, so that the length of branching is generally so long that there is many long-chain branching. Therefore, in order to obtain the polypropylene regin of desired drawdown nature, it is necessary to set up a reaction condition in consideration of these things. that which is too brief even if it has branching without long-chain branching -- or in the case of usual propylene system resin, drawdown nature will exceed a part for 60m/.
[0034] Extrusion foaming is performed using the resin with which drawdown nature exceeds a part for 60m/, and density is 0.09 - 0.4 g/cm3. If it is going to obtain sheet-like foam, since the foaming sheet obtained has much surface irregularity, its appearance as a product is bad, and since the smooth nature of a foaming sheet is spoiled, it will become what also becomes the cause which checks fabricating nature and a moldability and does not have commodity value. This is density even if it increases the amount of mixing of a foaming agent, if drawdown nature is in the propylene system resin exceeding a part for 60m/0.45 g/cm3 Since it is difficult to make it below and reinforcement of a cellular film cannot bear to the tension of the direction of extrusion at the time of foaming sheet manufacture, it is ********** to the direction of TD in a sheet on a mandrel. It is because crystallization of resin will start and a foaming sheet front face will become scale-shaped irregularity, if resin temperature is lowered in order to prevent it.

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[0035] Or the propylene system resin used by this invention d) Angular-frequency:omega given by dynamic viscoelasticity measurement of the resin in 230 degrees C (rad/sec.) Storage modulus: G' (dyn/cm2) In between It is 0.70<=alpha<=1.00 preferably. the relation shown in the following approximation (7) in the range of omega=0.1-1 -- being realized -- alpha in a formula, and beta -- respectively -- 0< alpha<=1.00 -- And 3.65<=beta<=4.50 and the dynamic viscoelasticity behavior which is 3.85<=beta<=4.35 preferably may be shown.
logG'= Alpha-log omega + beta .... (7)
[0036] In the above-mentioned formula (1), alpha logG' on the coordinate which sets a horizontal axis as logomega at an axis of ordinate It is the slope of a line which is called for by plotting two points, the value of logomega=-1 and logG' at that time, and the value of logomega=0 and logG' at that time, and which is shown by the formula (7), and beta shows the intercept with which the straight line shown by the formula (7) intersects the axis of ordinate of logomega=0. In the above-mentioned formula (7), by 1.00, alpha shows [beta] the straight line (Sign a is attached and shown.) ofbeta3.65 by 1.00, and alpha shows the straight line (Sign b is attached and shown.) of 4.50 to drawing 5 , respectively.
[0037] In drawing 5 , when the value of logomega is large, the dynamic viscoelasticity behavior shown by logG' expresses the elastic modulus of the resin of the condition that the property of an elastic body is strong, and is considered to be equivalent to the behavior of the resin at the time of the cellular formation just behind extrusion foaming in a foaming process. On the other hand, when the value of logomega is small, the dynamic viscoelasticity behavior shown by logG' expresses the elastic modulus of the resin of the condition that the property of the viscous body is strong, and is considered to be equivalent to the behavior of the resin for maintaining the air bubbles after said cellular formation in a foaming process. a polypropylene regin -- foaming -- setting -- extrusion foaming -- it can set -- air bubbles -- formation -- the back -- air bubbles -- maintaining -- making -- a sake -- angular frequency -- : -- omega -- one - 0.1 (rad/sec.) -- changing -- the time -- a storage modulus -- : -- G -- ' -- a value -- and -- rate of change -- a numeric value -- adopting -- specifying -- things -- having excelled -- foaming -- a sheet -- one -- it can obtain .
[0038] Even if angular frequency and a storage modulus are resin which has the relation shown in the above-mentioned formula (7), the cellular formation at the time of foaming becomes difficult as alpha in a formula (7) cannot check zero or less resin, but alpha approaches 0, when alpha is less than 0.7. On the other hand, in the case of the resin with which alpha exceeds 1.00, only the foam of low expansion ratio is obtained. Moreover, the foam obtained when beta is less than 3.65 resin has a low rate of a closed cell, only the foam of low expansion ratio is obtained, but even if it cannot cancel surface irregularity since the foam obtained has too strong melting tension in the case of the resin with which beta exceeds 4.50, but it makes foaming temperature high temporarily, it is difficult to maintain air bubbles and it becomes the bad thing of a surface state after all.
[0039] moreover, storage-modulus: -- it is thought that the behavior of cellular formation and maintenance of the resin represented by G' can be more certainly held by G', simultaneously loss-modulus:G" measured. That is, a difference may be looked at by the behavior of the cellular formation and maintenance in a foaming process even if the value of G' is the same polypropylene regin. The property of resin can be considered to be the combination of the property (equivalent to G') of an elastic body, and the property (equivalent to G") of a viscous object. That for this reason, the behavior of cellular formation and maintenance has a difference though G' is the same resin as mentioned above Loss modulus: As a result of paying one's attention to the value of tandelta which is considered to be because for G" to be different and is expressed with G"/G', angular-frequency:omega is 0.1-1 (rad/sec.). In within the limits The value of tandelta can manufacture still more easily 1.25-3.50, and the extrusion-foaming sheet that control of appearance, expansion ratio, and the rate of a closed cell became easier, and was excellent when it was between 1.30-2.70 more preferably.
[0040] The dynamic viscoelasticity of the above-mentioned resin is measured by the stress-control method in a linearity field with dynamic viscoelasticity testing machines (for example, the dynamic-viscoelasticity testing machine by REOMETO Rix Far East incorporated company: SR200 mold etc.). For example, measurement in a linearity field is stress 5000 dyn/cm2 It carries out. in addition, the case

where a polypropylene regin measures to maximum frequency 100rad/sec. in measurement with a stress-control method -- stress -- 2000 - 50000 dyn/cm2 it is -- if -- it becomes in a linearity field. Moreover, needless to say, a linearity field is a range where the measured value of viscoelasticity, such as the thing of the field which has a distortion rate and stress in proportionality, i.e., a storage modulus etc., is not influenced of stress. dynamic viscoelasticity -- a trial -- **** -- thickness -- about -- two -- mm -- measurement -- a sample -- resin -- a board -- a diameter -- 25 -- mm -- parallel -- a plate -- between -- inserting -- 230 -- degree C -- reaching -- until -- about -- ten -- a minute -- leaving it -- after that -- resin -- a board -- small -- pressing down -- resin -- a board -- parallel -- a plate -- concordance -- good -- carrying out -- further -- having overflowed -- resin -- shaving off -- since -- angular frequency -- : -- omega -- changing -- making -- angular frequency -- having corresponded -- a storage modulus -- : -- G -- ' -- and -- a loss modulus -- : -- G -- ' -- ' -- measuring .

[0041] Moreover, selection of the measurement temperature of the dynamic viscoelasticity of 230 degrees C is because it is the temperature which can express notably the behavior of the elastic-modulus change accompanying temperature lowering of a viscoelastic body, when elastic-modulus change of the viscoelastic body (polypropylene regin) accompanying temperature lowering until the melting resin by which extrusion foaming is carried out is extruded from an extruder dice at foaming temperature, air bubbles are formed and it solidifies is made to correspond with the elastic-modulus change accompanying angular-frequency lowering and it asks for it.

[0042] the line which contains the polypropylene of low molecular weight, using a metallocene catalyst as a polymerization catalyst at the time of angular frequency, a storage modulus, and the polypropylene regin that has the specific relation further described above between tandelta carrying out the polymerization of the polypropylene regin -- it can prepare suitably by irradiating radiation etc. to a polypropylene regin.

[0043] What has a branching characteristic below a1 which was mentioned above, and remarkable strain-hardening elongation viscosity in this invention, b) -- what has specific molecular weight distribution, specific balanced compliance, or shearing distortion recoverability, and the thing which shows the drawdown nature of c specification -- or d) Polypropylene regins which show one of the physical properties of these at least, such as that of which specific relation consists between the angular frequency and the storage moduli which are obtained by dynamic viscoelasticity measurement in a linearity field, are used suitably.

[0044] It not only uses the above-mentioned propylene system resin independently, but in this invention, it can mix and use other resin if needed. As resin mixed and used, vinyl chloride system resin, such as ethylene system resin, such as a propylene system resin [other than the above] or high-density-polyethylene, low-density-polyethylene, straight chain-like low-density-polyethylene, straight chain-like super-low-density-polyethylene, and ethylene-butene copolymer and an ethylene-maleic-anhydride copolymer, butene system resin, a polyvinyl chloride, and a vinyl chloride vinyl acetate copolymer, styrene resin, etc. are mentioned, for example.

[0045] Thus, when mixing other resin, the amount of the resin to mix limits to 40% of the weight of the AUW of the polymer after mixing.

[0046] After, carrying out melting kneading of a polypropylene regin and a foaming agent which were described above within an extruder for example, as it is shown in drawing 6 , using the annular dice which attached this melting kneading object at the head of an extruder and which has an annular lip, from the lip of this dice, extrusion foaming of the foaming sheet 1 of this invention is carried out, and it obtains cylinder-like foam, subsequently clears this cylindrical foam, carries out considering as the shape of a sheet etc., and is manufactured easily.

[0047] If the process which obtains cylindrical foam is further explained to details based on drawing 6 , extrusion foaming of the annular dice 5 which has the annular lip 4 at the head of an extruder 3 will be carried out from the lip 4 of installation and this dice. Obtain the foam 6 of the shape of a cylinder as shown in this drawing, and subsequently to the inside of this cylindrical foam 6, succeedingly, while cooling from the inside of foam 6 by the mandrel 7 which has arranged this cylindrical foam 6 It cools with means, such as spraying cooling air on the outside surface of foam 6, and after that, cylindrical

foam 6 is cleared in the shape of a sheet by the rotary knife 8, and it considers as a foaming sheet. In addition, nine in drawing is a mandrel base material.
[0048] In the above, the path of a mandrel 7 can be suitably chosen according to the width of face of the foaming sheet 1 which it is going to obtain. If the length of a mandrel 7 is sufficient length for cooling of cylindrical foam 6, it is arbitrary. Although an extrusion rate (line speed) changes with object thickness of discharge quantity and the foaming sheet 1 etc., the amount of 3-15m/is desirable in general. Although the cooling temperature of cylindrical foam 6 changes with above-mentioned extrusion rates etc., its 5-80 degrees C are in general desirable. A cooling means is not restricted to the above-mentioned method, but is arbitrary.
[0049] What is necessary is just to carry out adopting the dice of specific extrusion conditions and specific structure in the phase of manufacture of this cylindrical foam 6 etc., in order to consider as the specific thing which specifies that cellular configuration by this invention in obtaining the foaming sheet 1 of this invention.
[0050] Specific extrusion conditions pass an annular dice, holding lowering and high viscosity to the critical temperature in which the temperature control of the annular dice attached for example, at the head of an extruder is carried out to accuracy by the oil ** tone, and crystallization does not occur the temperature of resin.
[0051] Moreover, for the dice of specific structure, when passing the secondary breaker with which resin supports the shaft of an annular dice, the flow of resin is not interrupted, but while constituting a dice using the secondary breaker of the configuration which can maintain the condition near piston flow, the interior of a dice serves as sudden compression at the lip head, and the pressure inside a dice is 80kg/cm2. It considers as structure which becomes the following.
[0052] By manufacturing cylindrical foam 6 under the above specific conditions, the foaming sheet of a specific configuration [in / in air bubbles / abbreviation this invention] is obtained.
[0053] In carrying out and obtaining the foaming sheet 1 of this invention like the above, as a foaming agent, an inorganic foaming agent, an volatile foaming agent, a decomposable blowing agent, etc. can be used. A carbon dioxide, air, nitrogen, etc. are mentioned as an inorganic foaming agent.
[0054] As an volatile foaming agent, the mixture of a propane, n-butane, i-butane, n-butane, and i-butane, Annular aliphatic hydrocarbon, such as chain-like aliphatic hydrocarbon, such as a pentane and a hexane, a cyclobutane, and a cyclopentane, Trichlorofluoromethane, fluoro carbon 21, 1, and 1-dichloro - 1, 1, 1, 2-tetrafluoro ethane, Halogenated hydrocarbon, such as 1 and 1-difluoro-1-chloroethane, 1, 1 and 1, 2-tetrafluoro ethane, 1, and 1-difluoroethane, methyl chloride, ethyl chloride, and a methylene chloride, etc. is mentioned.
[0055] Furthermore, as a decomposable blowing agent, an AZOJI carvone amide, dinitrosopentamethylenetetramine, azobisisobutyronitril, sodium bicarbonate, etc. are mentioned. It can mix suitably and these foaming agents can be used.
[0056] The amount of the foaming agent used is density 0.09 - 0.4 g/cm3 eventually, although it changes with the class of foaming agent, expansion ratio for which it asks. The rule of thumb of the amount of the foaming agent used for obtaining a foaming sheet is [in an volatile foaming agent] about 0.03-0.45 mols in about 0.03-0.45 mols and a decomposable blowing agent per 1kg of resin at about 0.05-0.5 mols and an inorganic foaming agent.
[0057] In obtaining this invention foaming sheet 1, a cellular regulator can be added in the melting kneading object of resin and a foaming agent if needed. As a cellular regulator, a reaction mixture with the acid salt of inorganic powder, such as talc and a silica, or a multiple-valued carboxylic acid, a multiple-valued carboxylic acid and a sodium carbonate, or sodium bicarbonate is mentioned. It is desirable to add a cellular regulator below a 0.2 weight section degree per resin 100 weight section (however, when making resin contain so much the inorganic bulking agent mentioned later, it removes). Moreover, additives, such as a thermostabilizer, an ultraviolet ray absorbent, an antioxidant, and a coloring agent, can also be added further if needed.
[0058] Moreover, an inorganic bulking agent may be made to contain in resin beforehand within the limit of 40% of the weight of AUW. As an inorganic bulking agent, talc, a silica, a calcium carbonate,

clay, a zeolite, an alumina, a barium sulfate, a magnesium hydroxide, etc. are mentioned, for example. As for such mean particle diameter, it is desirable that it is 1-70 micrometers. When many such inorganic bulking agents are made to contain, while thermal resistance of the foaming sheet obtained improves, it becomes possible to reduce the combustion calorie in the case of incineration processing of it.

[0059] In this invention, the laminating of the resin sheet which made at least one side of the foaming sheet 1 contain an inorganic filler for rigid improvement, such as a printability, and improvement in surface hardness, further flexural strength, can also be carried out. By carrying out the laminating of such a resin sheet, the rigidity of a foaming sheet can be raised more, lip reinforcement of mold goods can be strengthened, and improvement in firmness and productivity can be aimed at.

[0060] The resin sheet contains the inorganic filler 15 to 50% of the weight preferably 5 to 70% to AUW, and this inorganic filler contributes it to the rigid improvement in a foaming sheet greatly. A remarkable effect is seen when fabricating a deep-drawing container especially using the foaming sheet 1 of this invention. If the rigid improvement effect is scarce and exceeds 70 % of the weight when an inorganic filler content is less than 5 % of the weight, it will have an adverse effect on a moldability. As the above-mentioned inorganic filler, talc, a silica, a calcium carbonate, clay, a zeolite, an alumina, a barium sulfate, glass, etc. are mentioned.

[0061] When carrying out the laminating of such a resin sheet to the foaming sheet 1, since the rigidity of the foaming sheet 1 is excellent as compared with the conventional thing even if 200 micrometers or less of thickness of this resin sheet are 180 micrometers or less preferably and it makes thickness thin with 200 micrometers or less, sufficient rigidity is acquired. Moreover, since the inorganic filler contains on the above-mentioned resin sheet, thermal resistance improves. If the thickness of a resin sheet exceeds 200 micrometers, heating temperature at the time of shaping must be made high, there is a possibility of causing the increment in the density of mold goods by heating compression at the time of about [that a moldability is spoiled] and shaping, and in case the obtained mold goods are kept, the height at the time of accumulating mold goods (stack height) will also become high.

[0062] As base material resin of a resin sheet, polyethylene system resin, a polypropylene regin, polyester system resin, acrylic resin, polyvinyl chloride system resin, polycarbonate system resin, etc. can be used. Points, such as recycle nature, an adhesive property, thermal resistance, oilproof, and rigidity, to a polypropylene regin is especially desirable, and it is more desirable to be [which constitutes the foaming sheet 1] resin, and that it is of the same kind. That is, if the base material resin of the foaming sheet 1 is a propylene-ethylene block copolymer, also as for the base material resin of a resin sheet, it is desirable that it is a propylene-ethylene block copolymer.

[0063] In carrying out the laminating of the resin sheet to the foaming sheet 1, as the laminating method, general methods, such as the laminating method by adhesives, such as the extrusion laminating method, the thermal laminating method, and hot melt, are employable.

[0064] this invention foaming sheet 1 can be fabricated in a desired mold-goods configuration using the method which combined free drawing shaping and plug - and - ridge forming, ridge forming, matched mold forming, straight shaping, drape forming, reverse draw shaping, air slip shaping, plug assist forming, plug assist reverse draw shaping, etc. and these as a vacuum forming, pressure forming, or these application.

[0065]

[Example] Next, a concrete example is given and this invention is further explained to details.

[0066] The configuration of the secondary breaker attached at the head of an extruder after carrying out melting kneading of an example 1 - 5 base-material resin, a foaming agent, and the cellular regulator within an extruder, and an annular dice is chosen suitably, and it is the pressure of dice circles 80 kg/cm3 It considered as the following, extrusion foaming of the above-mentioned melting kneading object was carried out by the discharge quantity shown in a table 1 on a mandrel from an annular lip, and cylinder-like foam was obtained. Subsequently, the mandrel top was passed for this cylindrical foam as it is, this was cleared in the shape of a sheet, and the foaming sheet was obtained. At this time, the oil temperature controller was formed in the dice section, and the temperature of the above-mentioned

melting kneading object was controlled at accuracy to a specific temperature within the limits of 160-170 degrees C. In addition, it is as follows for details (one to example 5 community).
[0067]
[Base material resin]
- Ethylene-propylene block copolymer MI ..... 2.0g / 10 minutes Crystallization temperature ..... 126 degrees C Melting point ..... 158 degrees C Drawdown nature ..... A part for 5m/ Melting tension ..... 23g Dynamic viscoelasticity ..... alpha= 0.8, beta= 4.2 tandelta=2.1-1.5 (omega= 0.1-1 rad/(second)) balanced compliance (210 degrees C and 100 N/m2 regularity, time amount 1 - 300 seconds) ..... 1.5x10-4 cm/dyn
Shearing distortion recovery ..... 6.2x10-5 cm/dyn (210 degrees C, 1/second of shear rates)
Weight average molecular weight (Mw) 3.7x105 (*1)
Z average molecular weight (Mz) 1.2x106 (*1)
**1: Waters150valve flow coefficient It is Column Waters, using GPC and using 135-degree-C trichlorobenzene as a solvent. Mu-Styrogel It measured the condition for HT (103, 104, 105, 106 **), 0.2 % of the weight [of solution concentration], and 1ml/of the rates of flow.
[Foaming agent]
- Butane [a cellular regulator]
- Citric-acid monosodium salt [an extruder]
- The loadings of the butane to the tandem extruder [combination and temperature condition] base material resin 100 weight section and citric-acid monosodium salt were shown in a table 1. Moreover, the temperature conditions of the primary breaker section in extrusion foaming were also collectively shown in a table 1.
[0068] Extrusion foaming was performed using the same base material resin as example of comparison 1 example, the foaming agent, and the cellular regulator on the combination and the temperature conditions over the base material resin 100 weight section shown in a table 1. In the extruder, ****** was attached in some dices using the usual secondary breaker. And the cylindrical foam obtained [make / into 30 kg/h / discharge quantity] by carrying out extrusion foaming was cleared, and the foaming sheet was obtained. In addition, the oil ** tone of the dice section did not carry out in the example 1 of a comparison.
[0069] Extrusion foaming was performed using the same base material resin as the example 2 of a comparison, and three examples, the foaming agent, and the cellular regulator on the combination and the temperature conditions over the base material resin 100 weight section shown in a table 1. In the extruder, it carried out by 80 kg/h usually through discharge quantity using a usual secondary breaker and a usual dice. In addition, the oil ** tone of the dice section did not carry out in the examples 2 and 3 of a comparison.
[0070]
[A table 1]

h g cg b eb cg e e

	発泡剤（重量部）	気泡調整剤（重量部）	1次ブレーカー部の温度（℃）	吐出量（kg／h）
実施例1	1．1	0．07	169	80
実施例2	1．8	0．064	167	80
実施例3	2．2	0．06	165	80
実施例4	2．9	0．057	164	80
実施例5	1．8	0．064	167	80
比較例1	1．8	0．035	167	30
比較例2	1．2	0．12	171	80
比較例3	2．0	0．09	169	80

[0071] While measuring each of the homogeneity of thickness, density, a cellular configuration, and air bubbles, the rate of a closed cell, and thickness nonuniformity about the foaming sheet obtained in examples 1-5 and the examples 1-3 of a comparison, it evaluated about the appearance of a moldability and a foaming sheet. A result is shown in a table 2. Moreover, it is a mimetic diagram based on the microscope enlargement of the cross section of the foaming sheet with which drawing 10 was obtained in the example 3 of a comparison based on the microscope enlargement of the cross section of the foaming sheet with which the mimetic diagram shown in drawing 1 was obtained in the example 2. In addition, the thickness direction cross section where drawing 10 (a) meets in the direction of MD, and drawing 10 (b) are the thickness direction cross sections which meet in the direction of TD, and 2' expresses air bubbles among drawing.
[0072]
[A table 2]

h g cg b eb cg e e

	厚み (mm)	密度 (g／cm³)	気泡形状			気泡の均一性			独立気泡率 (%)	厚みムラ (T_1／T_n)	成形性	外観
			A／B	A／C	A (mm)	A1／A2	B1／B2	C1／C2				
実施例1	2.0	0.300	0.52	0.51	0.18	0.87	0.97	0.95	90	0.98	◎	◎
実施例2	1.7	0.190	0.49	0.51	0.20	0.85	1.02	0.99	85	0.97	◎	◎
実施例3	1.5	0.150	0.38	0.53	0.21	0.84	0.84	0.98	80	0.94	◎	◎
実施例4	2.0	0.113	0.47	0.53	0.27	0.86	0.93	0.89	75	0.92	◎	◎
実施例5	1.7	0.190	0.48	0.47	0.18	0.75	0.95	0.95	80	0.93	○	○
比較例1	2.0	0.190	0.32	0.30	0.32	0.78	0.75	0.95	80	0.90	△	△
比較例2	2.0	0.27	0.25	0.17	0.08	0.87	1.01	0.86	85	0.85	×	×
比較例3	1.7	0.2	0.20	0.26	0.16	1.03	0.74	1.01	63	0.85	×	×

[0073] The cellular configuration measured the diameter A of average air bubbles of the thickness direction of each above-mentioned cross section, the diameter B of average air bubbles of the direction of MD, and the diameter C of average air bubbles of the direction of TD, and asked for the ratio (A/B,

h g cg b eb cg e e

A/C) of B and A to each of C while it observed each cutting cross section of the direction of MD, and the direction of TD. When each cross section was observed, the air bubbles of the foaming sheet of examples 1-5 had satisfied the requirements for this invention in the configuration. The air bubbles of the foaming sheet of the examples 1-3 of a comparison are flat configurations short for standing, and horizontally long, and were not satisfying the requirements for this invention.

[0074] Moreover, the value of diameter of average air bubbles A]/[the diameter B of average air bubbles of the direction of MD] of the [thickness direction Obtain the microscope enlargement of the thickness direction cross section of a direction which meets in the direction of MD of a foaming sheet, and the acquired photograph A basis, As the path of each above-mentioned direction is shown in drawing 2 about all the air bubbles (n>=50) that exist in thickness 5 times the width of face of the a of each air bubbles, a1 which measured the value of b with slide calipers for every air bubbles, and was obtained in this way, a2, a3, and ... an and a list -- b1, b2, b3, and ... bn The arithmetic mean is carried out. A/B which is the diameter A of the thickness direction average air bubbles, the diameter B of average air bubbles of the direction of MD, and its ratio was calculated from the dilation ratio of a microscope enlargement.

[0075] [Diameter A of average air bubbles of the thickness direction] the value of / [the diameter C of average air bubbles of the direction of TD] The microscope enlargement of the thickness direction cross section of a direction which meets in the direction of TD of a foaming sheet is obtained. a1 which measured the value of a of each air bubbles, and c for every air bubbles like the above, and was obtained in this way based on the acquired photograph, a2, a3, and ... an and a list -- c1, c2, c3, and ... cn The arithmetic mean is carried out. A/C which is the diameter A of the thickness direction average air bubbles, the diameter C of average air bubbles of the direction of TD, and its ratio was calculated from the dilation ratio of a microscope enlargement.

[0076] About the homogeneity of air bubbles, the microscope enlargement of the thickness direction cross section is obtained, and based on the acquired photograph, a line is drawn in 25% of location of thickness, and it divides [each / of the direction which meets in the direction of MD of a foaming sheet, and the direction which meets in the direction of TD] into the air bubbles of the surface section and the inner layer section from both the front faces of foam. About the air bubbles which exist in the surface section, and the air bubbles which exist in the inner layer section, and independently, respectively It is made to be the same as that of the above. It asks for the diameter C2 of average air bubbles of the diameter A1 of average air bubbles of the sheet thickness direction of the air bubbles which exist in the surface section, the diameter B1 of average air bubbles of the direction of MD, the diameter C1 of average air bubbles of the direction of TD, the diameter A2 of average air bubbles of the thickness direction of the sheet of each air bubbles which exist in the inner layer section, diameter B-2 of average air bubbles of the direction of MD, and the direction of TD by the arithmetic mean. The value of A1/A2, B1-/B-2, and C1/C2 was computed.

[0077] All the air bubbles that are in one (Tx5) 5 times the width of face of that thickness T reflected to a microscope enlargement in case this measurement is performed (all air bubbles that exist in the portion shown with the slash in drawing 7 .) however -- although drawing 7 shows the foaming sheet thickness direction cross section -- the graphic display of air bubbles -- omitting -- **** -- it considered as the measuring object. moreover, about the air bubbles which lap with the line of the location of 25% of overall thickness Mino of a foaming sheet If the portion exceeding 50% of the cross section of those air bubbles is located in the surface section Ts side, these air bubbles shall exist in the surface section Ts, and they are air bubbles 20. When the portion exceeding 50% of the cross section was located in the inner layer section Ti side, these air bubbles measured as what exists in the inner layer section Ti.

[0078] It asked for the rate of a closed cell of a foaming sheet by following the (8) type with the air relation aerometer.

Rate of a closed cell (%) =[Vx-Va(rhof/rhos)]/[Va-Va (rhof/rhos)] ... (8)

[-- however, only the effective cubic capacity (cm3) of Vx:foaming sheet sample, the capacity (cm3) to which only Va:foaming sheet sample is applied, and a rhof:foaming sheet sample are applied, and they are density (g/cm3) and the density (g/cm3) of rhos:resin.]

h g cg b eb cg e e

[0079] The foaming sheet 1 was divided in the direction of TD to Ranges alpha, beta, and gamma and ... which were divided every 100mm from one piece side edge section along the direction of TD about thickness nonuniformity to the piece side edge section of another side as shown in drawing 3 (however, the portion eta of the remainder with which 100mm is not filled as shown in drawing 3 was disregarded), and thickness was measured in 5mm pitch about each range. And the ratio (Tl/Tm) of the minimum thickness (Tl) and the maximum thickness (Tm) was calculated from the measured value. Tl/Tm in each range The smallest value was shown in a table 2 as central value of thickness nonuniformity inside. namely, -- for example, Tl in Range alpha / Tm alpha 0, Tl in Range beta / Tm beta 0, Tl in Range gamma / Tm gamma 0 it is -- alpha 0, beta 0, and gamma 0 Inside alpha 0 if the smallest -- alpha 0 It considered as central value.

[0080] About the moldability, much shaping tests of picking were continuously performed by plug assist vacuum forming with the continuous-molding machine. A target tray-like container is the dished container 30 which has stowages 32 and 33 on both sides of partition 31 as shown in drawing 8 , and each size of k-r is k:175mm, l:112mm, m:63mm, n:110mm, o:90mm, p:40mm, q:40mm, and r:35mm in drawing 8 . The error criterion of a moldability and the acquired error criterion of the appearance of mold goods are as follows. In addition, drawing 8 (a) is the plan of mold goods, and drawing 8 (b) is the side elevation of mold goods.

[0081] Error-criterion [of a moldability] O ..... In all mold goods, there is no YAKE of the stripe crack by the defect of thickness and a front face.

O ..... Although there is no stripe crack by poor thickness in all mold goods, some surface YAKE is in some mold goods.

** ..... Few stripe cracks and surface YAKE are in some mold goods.

x ..... The stripe crack has occurred in much mold goods.

[0082] Error-criterion [of appearance] O ..... A texture is fine, a flare is in air bubbles, and it is glossy.

O ..... Although a texture is fine, some Siwa is shown in a front face.

** ..... A texture is a little coarse and some Siwa is shown in a front face.

x ..... A texture will be coarse, Siwa will be shown in a front face, and it would have been in the uneven surface state crosswise.

[0083] Density and thickness were in abbreviation etc. by carrying out, contrasted the example 1, the example 2 of a comparison, and an example 2 and the example 3 of a comparison, respectively, and measured the flexural strength. A result is shown in a table 3. In addition, the flexural strength of a foaming sheet cuts out a test piece from each of the foaming sheet of the above-mentioned example and the example of a comparison by 25mm by 150mm. With a universal testing machine (tensilon by Cage En Tick company), the condition for 10mm/in the distance between the supporting points of 30mm, the radius of 2.5mm of susceptor, and beef fat speed Based on JIS-K7203, it measured by n= 3 about the direction of MD, and the direction of TD, respectively, and the arithmetic mean value of the average of the flexural strength of the direction of MD and the average of the flexural strength of the direction of TD was made into the flexural strength of a foaming sheet.

[0084]

[A table 3]

	密度 (g／cm^3)	厚み (mm)	曲げ強度 (kg／cm^2)
実施例1	0．30	2．0	7．5
比較例2	0．27	2．0	3．6
実施例2	0．19	1．7	3．0
比較例3	0．20	1．7	1．6

[0085] Although density and thickness carried out abbreviation coincidence as shown in a table 3, as for examples 1 and 2, the examples of a comparison twice [about] the flexural strength of 2 and 3 were shown, respectively.
[0086] With the configuration shown in a table 4 at the sheet-like foam obtained in examples 5-8, four to example of comparison 6 examples 2-4, and the examples 1-3 of a comparison, the inorganic filler content resin sheet was extruded, the laminating was carried out by the laminating method, and mold goods were obtained using the laminating sheet. As base material resin of an inorganic filler content resin sheet, the masterbatch (the product made from JPO, KS 3268-6) of the talc content PP base was used 30%.
[0087]
[A table 4]

	発泡シート	発泡シートの坪量（g／m²）	樹脂シート			全体の坪量（g／m²）	成形性	リップ強度（g）
			厚さ（μm）	片面or両面	坪量（g／m²）			
実施例5	実施例2の発泡シート	325	87	片面	100	425	◎	237
実施例6	実施例2の発泡シート	〃	87	両面	200	525	◎	348
実施例7	実施例3の発泡シート	225	174	片面	200	425	◎	260
実施例8	実施例4の発泡シート	225	174	片面	200	425	◎	240
比較例4	比較例1の発泡シート	325	87	片面	100	425	◎	190
比較例5	比較例2の発泡シート	540	87	片面	100	640	×	190
比較例6	比較例3の発泡シート	340	87	片面	100	440	×	175

[0088] Although the thickness of an inorganic filler content resin sheet was a less than 200-micrometer thin object, a moldability and rigid all of the obtained mold goods were good. In addition, assessment of a moldability fabricated the tray-like container, as the inorganic filler content resin sheet side turned into an inner surface at least, and it was performed by the same error criterion as the above.

[0089] Moreover, in order to judge whether mold goods have practical reinforcement, lip reinforcement was measured by the following methods. A result is collectively shown in a table 4.

h g cg b eb cg e e

[0090] The test sample was created for the mold goods 40 of the configuration shown in measuring method drawing 9 (a) of lip reinforcement, and (b) at the single-engined making machine, and as shown in drawing 9 (b), the edge section (the slash in drawing shows) was cut 5mm. Next, as shown in drawing 9 (c), the sample was put by having considered the portion which cut the edge section between a load cell 41 and susceptor 42 as the upper and lower sides, and the compressive strength in the event of the gap of a load cell 41 and susceptor 42 being set to 150mm was measured as lip reinforcement. In drawing 9 , each size of s-w is s:180mm, t:160mm, u:120m, and v:30 mm:w:170mm. In addition, drawing 9 (a) is explanatory drawing in which the cross section of mold goods and drawing 9 (b) show the plan of mold goods, and drawing 9 (c) shows the measuring method of lip reinforcement.
[0091]
[Effect of the Invention] As explained above, the non-constructed bridge polypropylene regin foaming sheet for shaping of this invention While being 0.5-8mm in density 0.09 - 0.4 g/cm3, and thickness, and 70% or more of rates of a closed cell When the diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A, B, and C, respectively Since a cellular configuration satisfies following the (1) - (3) type, is long in the thickness direction as compared with the former and is a cellular configuration more near a globular form Since it excels in compressive strength and flexural strength while having high rigidity and the outstanding buffer nature simultaneously it not only excelling in a moldability, but, even if it made density low, practical reinforcement was not spoiled, but it fully has the rigidity demanded as a foaming sheet for shaping. Moreover, since air bubbles are also fine, appearance is also good.
$0.35<A/B<0.65$ ... (1)
$0.35<A/C<0.65$ ... (2)
$0.10 -- < -- A <=0.4$ ... (3)
[0092] moreover, in addition to the above-mentioned conditions, in this invention, about the air bubbles which exist in the surface section The diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A1, B1, and C1, respectively. And when the diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A2, B-2, and C2 about the air bubbles which exist in the inner layer section, respectively By specifying a cellular configuration so that following the (4) - (6) type may be satisfied, a cellular configuration has little variation in the surface section and the inner layer section of a foaming sheet, air bubbles become uniform in the thickness direction of a foaming sheet, and it becomes what was more excellent in the moldability. Moreover, if air bubbles are uniform in the thickness direction of a foaming sheet, the rigidity of a foaming sheet will improve further.
$0.8<A1/A2 <=1.2$ ... (4)
$0.8<B1/B-2<=1.2$ ... (5)
$0.8<C1 / C 2<=1.2$ ... (6)
[0093] Furthermore, when thickness is measured along the direction of TD in this invention Because the ratio (Tl/Tm) of the maximum thickness (Tm) in within the limits and the minimum thickness (Tl) of each which divided the foaming sheet from one piece side edge section at intervals of 100mm to the piece side edge section of another side covering the direction of TD carries out to 0.90 or more It seems that it carries out [that the thin portion of a sheet is locally lengthened at the time of thermoforming, etc. and], and it is not said that it becomes a thing inferior to a moldability.
[0094] Moreover, if the laminating of the resin sheet of 5 - 70 % of the weight of inorganic filler contents with a thickness of 200 micrometers or less is carried out to at least one side of the non-constructed bridge polypropylene regin foaming sheet of this invention, the rigidity of a foaming sheet can be raised more, lip reinforcement of mold goods can be strengthened, and improvement in firmness and also a moldability, and productivity can be aimed at.

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] A non-constructed bridge polypropylene regin foaming sheet for shaping which is a non-constructed bridge polypropylene regin foaming sheet for shaping of 0.5-8mm in density 0.09 - 0.4 g/cm3, and thickness, and 70% or more of rates of a closed cell, and is characterized by a cellular configuration satisfying following the (1) - (3) type.
0.35<A/B<0.65 ... (1)
0.35<A/C<0.65 ... (2)
0.10 -- < -- A <=0.4 ... (3)
[-- however, each in [A, B, and C] a formula is a diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD), and the unit is mm.]
[Claim 2] About air bubbles which exist in the surface section of less than 25% of overall thickness Mino of this sheet from a front face of a foaming sheet A diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A1, B1, and C1, respectively. and about air bubbles which exist in the inner layer section which crosses 25% of overall thickness Mino of this sheet from a front face of a foaming sheet A non-constructed bridge polypropylene regin foaming sheet for shaping according to claim 1 with which it is satisfied of following the (4) - (6) type when a diameter of average air bubbles in the thickness direction of a foaming sheet, the direction of extrusion (the direction of MD), and the cross direction (the direction of TD) is set to A2, B-2, and C2, respectively.
0.8<A1/A2 <=1.2 ... (4)
0.8<B1/B-2<=1.2 ... (5)
0.8<C1 / C 2<=1.2 ... (6)
[Claim 3] A non-constructed bridge polypropylene regin foaming sheet for shaping according to claim 1 or 2 whose ratio (Tl/Tm) of the maximum thickness (Tm) in within the limits and the minimum thickness (Tl) of each which is divided at intervals of 100mm from one piece side edge section over the cross direction (the direction of TD) to the piece side edge section of another side is 0.90 or more when thickness is measured along the cross direction (the direction of TD) of a foaming sheet.
[Claim 4] A non-constructed bridge polypropylene regin foaming sheet for shaping according to claim 1, 2, or 3 which comes to carry out the laminating of the resin sheet of 5 - 70 % of the weight of inorganic filler contents with a thickness of 200 micrometers or less to at least one side.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the mimetic diagram showing the longitudinal section of the polypropylene regin foaming sheet (example 2) of this invention.
[Drawing 2] It is drawing for explaining the semantics of the diameter of air bubbles in this invention.
[Drawing 3] It is drawing explaining dividing a foaming sheet in the direction of TD in this invention.
[Drawing 4] It is equipment explanatory drawing for measuring drawdown nature.
[Drawing 5] It is the straight line which approximated the curve plotted on the coordinate which shows an example of the dynamic viscoelasticity of the polypropylene regin which can be suitably used in this invention, sets a horizontal axis as logomega for storage-modulus G' corresponding to each frequency omega obtained by dynamic viscoelasticity measurement in the linearity field in 230 degrees C, and sets an axis of ordinate as logG'.
[Drawing 6] It is the conceptual diagram showing a part of manufacturing process of the polypropylene regin foaming sheet of this invention.
[Drawing 7] It is explanatory drawing showing the cellular portion made into the measuring object in the example and the example of a comparison.
[Drawing 8] In order that a moldability may evaluate in an example and the example of a comparison, it is explanatory drawing showing the obtained mold goods.
[Drawing 9] They are explanatory drawing showing the mold goods obtained in order to measure the lip reinforcement of mold goods in an example and the example of a comparison, and explanatory drawing showing the measuring method of lip reinforcement.
[Drawing 10] It is the mimetic diagram showing drawing of longitudinal section of the conventional polypropylene regin foaming sheet (example 3 of a comparison).
[Description of Notations]
1 Non-Constructed Bridge Polypropylene Regin Foaming Sheet
2 Air Bubbles

[Translation done.]

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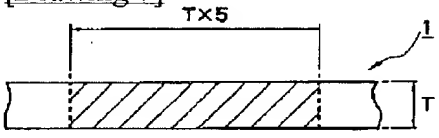
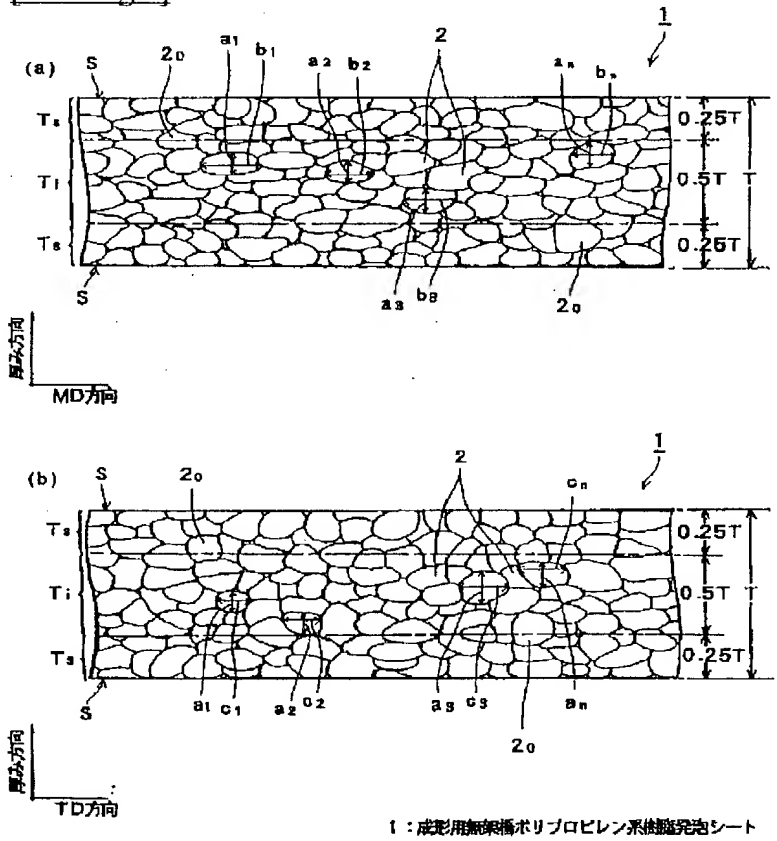
DRAWINGS

[Drawing 7]



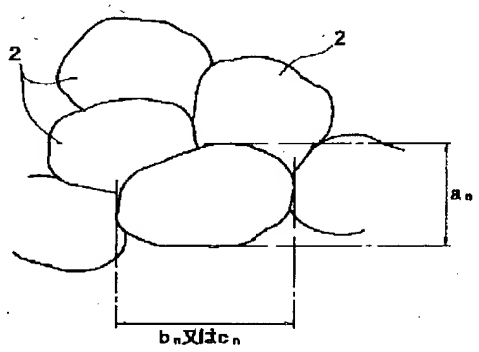
[Drawing 1]



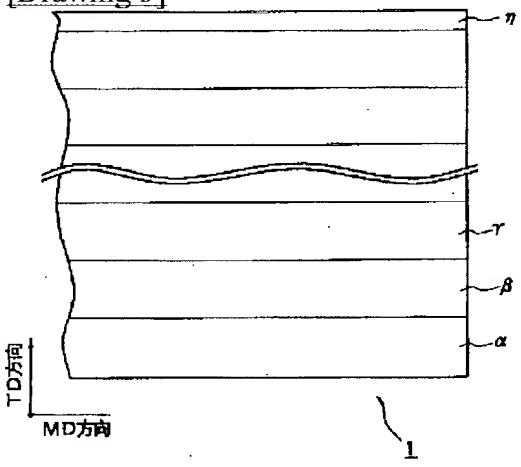
1：成形用無架橋ポリプロピレン系樹脂発泡シート
2：気泡

[Drawing 2]

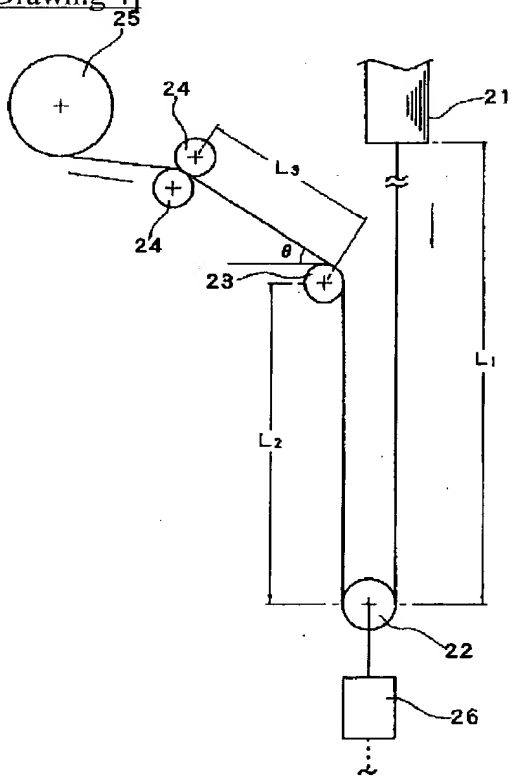
h g cg b eb cg e e



[Drawing 3]

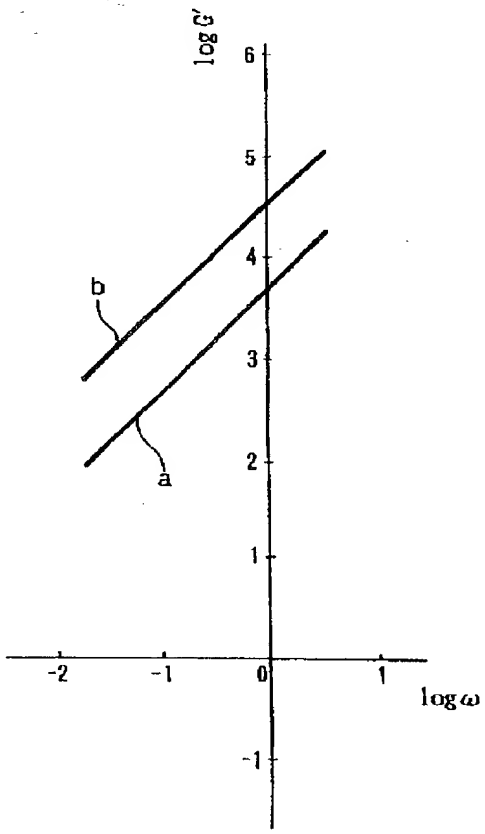


[Drawing 4]

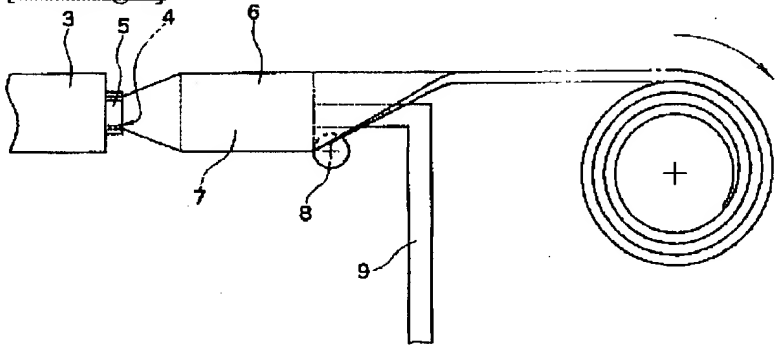


[Drawing 5]

h g cg b eb cg e e



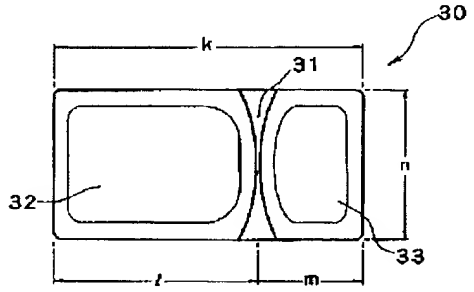
[Drawing 6]



[Drawing 8]

h g cg b eb cg e e

(a)



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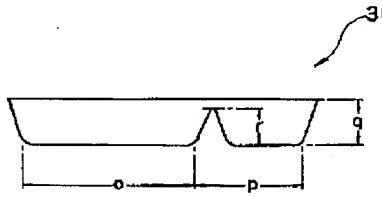
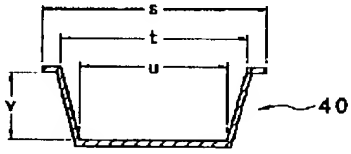


[Drawing 9]

(a)



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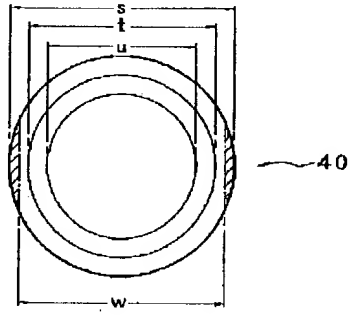

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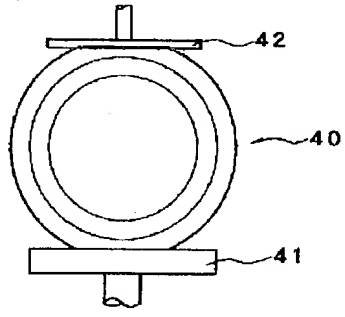
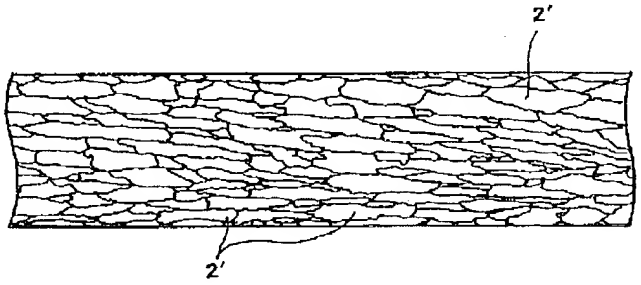


[Drawing 10]

h g cg b eb cg e e

(a)



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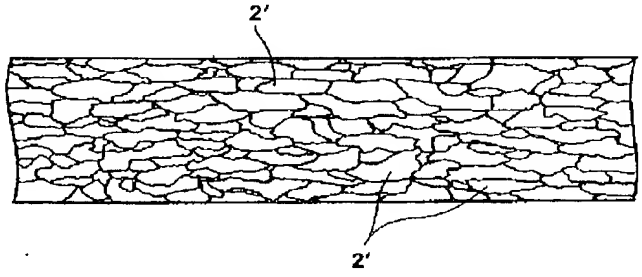

[Translation done.]

h g cg b eb cg e e